

REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>						
1. REPORT DATE (DD-MM-YYYY) 29-02-2012		2. REPORT TYPE Final Performance		3. DATES COVERED (From - To) 01-03-2009 to 30-11-2011		
4. TITLE AND SUBTITLE QUASI-PHASEMATCHED NONLINEAR OPTICS: MATERIALS AND DEVICES				5a. CONTRACT NUMBER NA		
				5b. GRANT NUMBER FA9550-09-1-0233		
				5c. PROGRAM ELEMENT NUMBER 61102F		
				5d. PROJECT NUMBER 09NE206		
6. AUTHOR(S) Martin Fejer fejer@standford.edu 650-725-2160				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Laland Stanford Junior University Office of Sponsored Research 340 Panama St Stanford, CA				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR 875 N Randolph St Arlington, VA 22203 Dr. Howard Schlossberg/RSE				10. SPONSOR/MONITOR'S ACRONYM(S)		
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL-OSR-VA-TR-2012-1092		
12. DISTRIBUTION/AVAILABILITY STATEMENT Distribution A: Approved for Public Release						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT The objective of this research is to study and improve the quality and performance of important nonlinear optical materials pioneered by the principal investigator, and to study new or improved device concepts made possible by these materials.						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON	
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (Include area code)	

Reset

Final Report
QUASI-PHASEMATCHED NONLINEAR OPTICS: MATERIALS AND DEVICES
FA9550-09-1-0233
Martin Fejer

Initial research in the area of supercontinuum (SC) was motivated by the SC generation in bulk periodically poled Lithium Niobate (PPLN) carried out by Hänsch et al. In this earlier work, there was no model for the physics underlying $\chi^{(2)}$ SC generation, so the work was purely empirical, but still resulted in octave-class SC and envelop locking with both 1.08- μm Yb: fiber and 1.5- μm Er: fiber pumps. Under this AF-supported program, a numerical simulation tool for octave-spanning $\chi^{(2)}$ processes was developed, that elucidated the mechanisms underlying the empirical results, and made predictions in quantitative agreement with the experimental observations. This analysis showed that a complex combination of cascaded $\chi^{(2)}$ processes, self-phase modulation, cross-phase modulation, and Raman effects all contribute, and that the group velocity dispersion in the vicinity of the pump wavelength and are important factors influencing the breadth and structure of the generated SC.

Based on these results, a heuristic picture for designing QPM gratings with $K_g(z)$ trajectories that accomplish specific goals, e.g soliton self-frequency shift, SC generation, etc. emerged, and could then be optimized with the numerical simulation tool. Generation of broader and flatter SC would be a goal in future research.

As a first demonstration of the utility of bulk periodically oriented gallium arsenide (OPGaAs) materials for broadband ultrafast mid-IR devices, a soliton self-frequency shift in a fluoride fiber to generate a 50-fs-long 2.5- μm pulses from a 150-fs-long 1.95- μm pump pulses from a Tm: fiber laser was used, and then those difference-frequency mixed pulses were used in an OPGaAs crystal to generate frequency combs in the 7-12 μm region. The wavelength of these spectra was tuned through the use of an OP-GaAs crystal with a fan-shaped QPM grating, translation of which through the pump beams controlled the QPM grating k-vector encountered by the beams. The results were again in quantitative agreement with the predictions based on a simulation tool.